



# Time

## Introduction to Time

Time is the duration in which events occur. It plays a crucial role in our daily lives. We rely on time to manage our activities, such as attending school on time, catching a bus, train, or flight, and tuning into scheduled television or radio programs. Watches and clocks are the primary devices used for time measurement.

## Measuring Time

**Short intervals of time:** Measured using stopwatches and digital timers.

**Long durations of time:** Measured using wall clocks, digital clocks, and atomic clocks.

**Ancient methods:** Sundials, sand clocks, water clocks, and candle clocks were used before the invention of mechanical clocks.

## Key Scientists in Time Measurement

**Galileo Galilei:** Studied motion and time using pendulums and inclined planes.

**Isaac Newton:** Established three laws of motion that are fundamental to understanding speed and movement.

**Christiaan Huygens:** Invented the pendulum clock to measure time accurately.

**Albert Einstein:** Revolutionized our understanding of time and space through the Theory of Relativity.

**Marie Curie:** Applied motion principles in her research on radioactive decay.

## Measurement of Time in Ancient Times

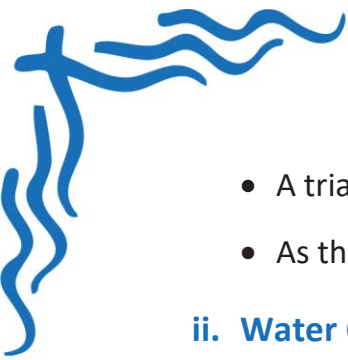
People measured time using natural occurrences before the invention of clocks. Examples:

- **Day:** Time taken between one sunrise to the next sunrise.
- **Month:** Time between one new moon to the next new moon.
- **Year:** Time taken by Earth to complete one revolution around the Sun.

## Ancient Time-Measuring Devices

### i. Sundial

- One of the earliest time-measuring devices.
- Measures time using the position of the shadow cast by the Sun.



- A triangular blade (gnomon) is fixed vertically on a marked dial.
- As the Sun moves, the shadow changes position, indicating the time.

## ii. Water Clock

- Measures time using the rate at which water drips from one vessel to another.
- The time taken for the complete transfer of water from the upper vessel to the lower vessel is used to measure time intervals.

## iii. Sand Clock (Hourglass)

- Uses the flow of sand to measure time.
- Consists of two glass bulbs connected by a narrow tube.
- The time taken for the sand to pass through determines a fixed time interval.

## iv. Candle Clock

- Uses a candle with nails inserted at fixed gaps.
- As the candle burns, the nails fall onto a metal plate, producing sound at regular intervals.

## The Need for Accuracy in Time Measurement

- Ancient instruments were not very accurate.
- The invention of mechanical clocks allowed more precise timekeeping.
- Christiaan Huygens invented the first pendulum clock in 1656, which used periodic motion to measure time.

## Periodic Motion and the Simple Pendulum

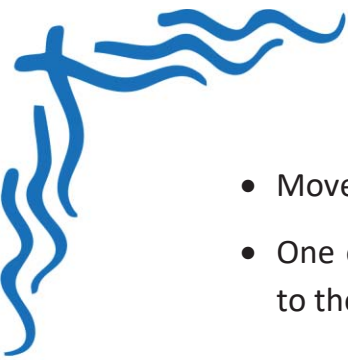
### Definition of Periodic Motion

Any motion that repeats itself at fixed intervals is called periodic motion. Examples:

- Rotation of Earth on its axis (one full rotation = one day).
- Revolution of Earth around the Sun (one full revolution = one year).
- Motion of a simple pendulum.

### The Simple Pendulum

- Consists of a small mass called a bob, suspended from a fixed point using a long string or rod.



- Moves freely under gravity in oscillatory motion.
- One oscillation is completed when the bob moves from one extreme position to the other and back.

### Important Terms Related to a Simple Pendulum

**Length of the pendulum:** The distance from the fixed suspension point to the center of the bob.

**Mean position:** The resting position of the pendulum bob.

**Extreme positions:** The maximum distance the bob moves from its mean position.

**Amplitude:** The maximum displacement of the bob from its mean position.

**Time period:** The time taken to complete one oscillation.

### Pendulum Time Period Calculation

**Formula:**

$$\text{Time Period} = \frac{\text{Total Time}}{\text{Number of Oscillations}}$$

**Example:** If a pendulum takes 48 seconds to complete 20 oscillations, the time period is:

### Latest Developments in Time Measurement

**Quartz Clocks:** Use quartz crystals to measure time accurately.

**Quartz Property:** Quartz oscillates when subjected to an electric current, helping maintain precise timekeeping.

**Stopwatches:** Used for short time measurements in sports events.

### Units of Time Measurement

The standard unit of time is second (s).

Larger units include:

- |                               |                             |
|-------------------------------|-----------------------------|
| • 1 minute (min) = 60 seconds | • 1 year = 12 months        |
| • 1 hour (h) = 60 minutes     | • 1 decade = 10 years       |
| • 1 day = 24 hours            | • 1 century = 100 years     |
| • 1 month = ~30 days          | • 1 millennium = 1000 years |